Introduction

Thanks to its design, the OTN (Open Transport Network) can handle nearly all existing communication standards for voice, data, LAN and video.

The system is based on dual, self-healing, counter-rotating optical rings. On top of this, the OTN-X3M version of the product offers a redundant common logic card for increased reliability and non-stop servicing.

The ring is synchronous, bandwidth is reserved by the OMS (OTN Management System) for each application, resulting in a never-blocking and fully predictable system behavior.

The BORA2500-X3M-ULM, referred to as “ULM” (Universal Link Module) in the remainder of this sheet, is the node’s redundant common logic card, which interfaces between the interface cards and the optical ring. The ULM function makes it possible to also act as a gateway between OTN-X3M and OTN rings.

The ULM combines the OTN-X3M-2500 common logic card with an OTN-150/600 common logic card on a single board. This co-location of OTN-X3M and OTN logic enables seamless interconnection of services between OTN-X3M-2500 and OTN-150/600 sub networks.

The ULM is part of a ring with a capacity of 2500 Mbps on the OTN-X3M side, and a capacity of 150 Mbps or 600 Mbps towards OTN-150/600.

The ULM can be equipped with maximum four hot-pluggable SFP (Small Form Factor Pluggable) modules, 2 for the OTN-X3M ring and 2 for the interconnection with an OTN-150 or OTN-600 ring.

Different modules for different distances are available for multimode or single-mode fiber. The ULM is SDH STM-16c and SONET OC-48c compatible on the OTN-X3M-2500 ring.

FEATURES

- Allows seamless interconnection between OTN-X3M-2500 and OTN-150/600 networks
- Redundant Ring coupling with fast (120ms) switch-over
- The OTN-X3M-2500 network is SDH STM-16c and SONET OC-48c compliant
- The BORA2500-X3M-ULM has four SFP-type hot-pluggable optical modules that can be replaced while the node stays in operation: 2 SFPs for the OTN-X3M network and 2 SFPs for the interconnection with OTN-150/600
- 10Base-T Ethernet port for connection to OMS (OTN Management System) over standard IP
Features

The ULM integrates the following functions on one card:

Managing and interfacing the OTN-X3M optical ring

The OTN-X3M optical ring is managed in a distributed way by all OTN-X3M common logic cards connected to it (BORA, ULM and/or ETX). The distributed management of the OTN-X3M common logic cards initialize, select a ring master for synchronization and close the ring. The common logic cards will loop back the ring if required due to broken fibers or interface cards (IC) that need to be removed.

No single point of failure exists.

Data Transport

The OTN-X3M data stream is transmitted between nodes in an STM-16c or OC-48c configuration. The SDH/SONET link layer carries out the clock synchronization, bit error rate measurement and word alignment.

The ULM places the OTN-X3M frame in the SDH/SONET payload. The OTN-X3M frame carries both data (for the interface cards) and control signals (such as the internode communication).

Microcontroller and in-band management channel

A fast PowerQUICC microprocessor running embedded Linux is capable of interconnecting an OTN-X3M in-band OTN-X3M optical ring, interfacing with any of the interface slots. The ULM contains the necessary hardware and software to support the HX4 mode (4 slots on the ULM card and any interface card, and avoids any mutual disturbances.

Managing and interfacing the communication between the ULM and the interface cards

A data connection can either be fixed, or switchable. If made switchable, a connection can be controlled by external management applications (e.g. video or audio switching) or user domains (reserved system resources), dynamic bandwidth allocation can be used.

The switching speed depends upon the ring size, but is faster than 50 ms. Fixed connections can only be modified by the OMS.

A star shaped data path between the ULM and the interface cards allows simultaneous data transfer at full speed between the ULM card and any interface card, and avoids any mutual disturbances.

Controlling the node and interface cards

The ULM card tests and manages the node and the interface cards. For that purpose, a management channel offers 192 kbps full duplex HDLC-based communication between the ULM and any of the interface slots. The ULM displays the actual state of the node and the interface cards, and communicates the processing power and flexibility for intelligent node management.

Controlling the data exchange between interface cards and optical ring

The ULM determines which data is exchanged between the interface cards and the ring, making sure no interface card will disturb data from other interface cards. The allocated bandwidth of the interface cards depends on the interconnection of interface cards and OTN-X3M frame is implemented in the GRIA E-G master that contains the traffic data. The bandwidth of the ring is determined by the ULM card. The ULM card can directly communicate with the interface cards and exchange up to 2.3 Gbps of data from the ring, and exchange up to 196 Mbps (XK mode) with every interface card in the node or up to 784 Mbps with interface slots that support the AX4 mode (4 slots on the left of the BORA in N42/N42C nodes @ 2.5 Gbps, all 4 slots in N415).

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Functional blocks

In order to carry out all these tasks, the ULM card is equipped with two SDH/SONET termination blocks, several field-programmable gate arrays (FPGA) and a microprocessor platform.

Two SDH/SONET termination blocks terminate the SDH/SONET signal of OTN-X3M, perform synchronization and clock recovery and transfer the OTN-X3M data as SDH/SONET payload over the optical link.

The main gate array (GRIA-E = Gigabit Ring Interface Adapter - Enhanced) contains the logic to support the optical OTN-X3M rings (i.e. generation and recognition of time-multiplexed OTN-X3M-frames, synchronization with the other nodes, management of the link status, and exchanges data with an add/drop function between ring and interface cards. The GRIA-E also exchanges data with the ULM-FPGA for realizing a cross connect between OTN-X3M and OTN. The ULM-FPGA contains the logic to support the OTN rings and allows the connection of selected services between the OTN-X3M and OMS. New FPGA configuration data can be downloaded from the OMS.

An industrial microcontroller running embedded Linux initializes, controls and monitors the ULM and the interface cards. The microcontroller also receives control data from the OMS, and stores them in a non-volatile RAM memory. Together with an Ethernet switch IC, the processor handles and relays management data between OMS (and/or other ULM-X3M nodes and connected OTN nodes). The data add and drop handling in an OTN-X3M and OTN cards, and exchange data in the OTN-X3M and OTN rings with the ULM, the network management is controlled by the OMS card connected to a ULM-X3M BORA.

An embedded 10 Mbps Ethernet ring carrying IP traffic interconnects the OMS to all the nodes in an OTN-X3M ring. The ULM card is capable of handling all status information from the node, the ring and the interface cards, and makes it accessible to the OMS. The ULM also receives and checks all commands from the OMS, and controls the output or passes them on to the relevant interface card.

When the ULM is used for interconnecting with an OTN-150/600 ring it will act as a central node in that interconnected OTN ring and thus it will relay the network management channel coming from the OTN-X3M ring to the interconnected OTN ring.

Transceiver types

The OTN-X3M 2500-X3M-XLM modular converts the OTN-X3M and OTN rings’ optical signal to an equivalent electrical signal, and vice versa. They can be replaced via the front of the ULM (hot swappable) and used LC optical connectors.

For the OTN-X3M ring the M (multimode), I (Intra-OTN-X3M) and S2 (Short haul), and L1 and L2 (Long haul) transceiver types are available. As mentioned before, OTN-X3M-2500 uses SDH STM-16c/SONET OC-48c framing on the optical rings.

For the OTN connection the I (Intra-Office), S1 (Short haul), L1 and L2 (Long haul), and V2 transceiver types are available. The optical characteristics are listed in a separate sheet.

Specifications

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<th>Connectors</th>
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<td>• ETH</td>
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<td>• SFP slots</td>
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On-board Indications

The front-panel alphanumeric display shows the BORA2500-X3M-XLM type and data regarding node operation and monitoring information. A push-button allows for scrolling through extended data sets.

The Ethernet L, R and T LEDs indicate the traffic flow of the SDH/SONET payload.

The SDH and BER LEDs report data transmission errors, whereas the SY2 and SY0 LEDs indicate the ring’s synchronization status.

Reset

A hidden reset button allows to reset the microcontroller, without disturbing the node’s add/drop functionality.

Status information

The following status information is available from the board:

• Optical link status
• SFP types (I, M, S1, S2, L1, L2, V2)
• Firmware version

Temperature sensor

A temperature sensor is provided on the BORA2500-X3M. The measured temperature is displayed.

Ordering Information

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<th>Nodes</th>
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<tr>
<td>The BORA2500-X3M-XLM module can be ordered separately (see separate sheet)</td>
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<tr>
<td>• BORA2500-X3M-XLM150-4: S30624-Q123-X216 (N42, OTN-150)</td>
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<td>• BORA2500-X3M-XLM150-8: S30624-Q123-X212 (N42/ N42C, OTN-150)</td>
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<td>• BORA2500-X3M-XLM600-4: S30824-Q123-X228 (N42/ N42C, OTN-600)</td>
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OMS Software Release:

OMS v5.1 and up

Electromagnetic Compatibility

Emission: EN 61000-6-2

Immunity: EN 61000-6-4, EN 55022, Class B

Note: SFP OT Module for OTN-2500 and OTN-150/600 need to be ordered separately (see separate sheet)